IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Patent Application

Appellant(s):	Dennis R. Morgan
Docket No:	Morgan 13
Serial No.:	10/775,911
Filing Date:	February 10, 2004
Group:	2613
Examiner:	Christina Y. Leung
Title:	Method and Apparatus for Two-Port Allpass Compensation of Polarization Mode Dispersion

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REPLY BRIEF

Mail Stop Appeal Brief – Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

Appellant hereby replies to the Examiner's Answer, mailed December 4, 2008 (referred to hereinafter as "the Examiner's Answer"), in an Appeal of the final rejection of claims 1-5, 7-12 and 14-22 in the above-identified patent application.

REAL PARTY IN INTEREST

A statement identifying the real party in interest is contained in Appellant's Appeal Brief.

RELATED APPEALS AND INTERFERENCES

A statement identifying related appeals is contained in Appellant's Appeal Brief.

STATUS OF CLAIMS

A statement identifying the status of the claims is contained in Appellant's Appeal Brief.

STATUS OF AMENDMENTS

A statement identifying the status of the amendments is contained in Appellant's Appeal Brief.

SUMMARY OF CLAIMED SUBJECT MATTER

A Summary of the Invention is contained in Appellant's Appeal Brief.

STATEMENT OF GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

A statement identifying the original grounds of rejection to be reviewed on appeal is contained in Appellant's Appeal Brief. In the Examiner's Answer, a new ground of rejection was presented. Claims 1 through 22 are rejected under 35 U.S.C. 101.

CLAIMS APPEALED

A copy of the appealed claims is contained in an Appendix of Appellant's Appeal Brief.

ARGUMENT

New Section 101 Rejection

Claims 1-22 are rejected under 35 U.S.C. 101 because the claimed invention is directed to non-statutory subject matter. In particular, the Examiner asserts that, reading the claims 1-22 in light of the specification, the recited method or apparatus encompasses software (i.e., functional descriptive material), that does not fall within any of the statutory subject matter.

Appellant notes that the independent claims require "a cascade of all-pass filters" and that, therefore, claims 1-22 fall within the statutory categories. Applicant respectfully requests that the section 101 rejections be withdrawn.

Section 103 Rejections

In the Examiner's Answer, the Examiner asserts that McFarlane teaches polarization dispersion compensation because McFarlane teaches compensating signal irregularities including polarization.

Contrary to the Examiner's assertion, while MacFarlane et al. may address optical filtering and polarization, there is no disclosure or suggestion to *compensate for polarization*

mode dispersion. The term "polarization mode dispersion" does not even seem to appear in MacFarlane et al.

The Examiner also reiterates that Eyal teaches adjusting coefficients using a Newton algorithm since Eyal teaches "using a Newton algorithm to optimize variables in equations for producing optimized filter coefficients."

Contrary to the Examiner's assertion, Eyal et al. does **not** teach that filter coefficients are adjusted using a Newtown algorithm in the discussion on page 1089, end of first par. of right column. While the Newton algorithm is discussed in this passage, it is **not** in connection with the adjustment of filter coefficients. Rather, the discussion at page 1089, end of first par. of right column, is directed to correction of *optimization variables*. The *optimization variables* are clearly distinct from the coefficients in the preceding discussion in the same paragraph.

Appellant has already acknowledged that the use of the Newton algorithm for adapting FIR filters is both well-known and straightforward. Appellant strongly asserts, however, that it would not have been obvious to a person of ordinary skill in the art to apply the Newton algorithm to the adaptation of all-pass filters. It is not known to adapt all-pass filters using the Newton algorithm. Furthermore, the adaptation equations for FIR filters do not apply to the adaptation of an all-pass filter.

In the Examiner's Answer, the Examiner asserts that it would have been obvious to a person of ordinary skill in the art to substitute one minimization algorithm for another in optimizing the all-pass filters disclosed by Madsen to achieve a predictable result of optimizing the filter coefficient values.

Appellant refers the board to the arguments presented in the Appeal Brief in regard to *KSR*.

In the Examiner's Answer, the Examiner notes, in regard to Appellant's argument that "the adaptation equations for FIR filters do not apply to the adaptation of an all-pass filter," that the rejected claims do not recite particular equations.

Appellant notes that the cited argument was presented to illustrate that the Examiner's proposed combination of references was *not* valid because the combination suggested by the Examiner *would not work*. Appellant's argument is valid regardless of whether the equations are recited in the claims.

Appeal Brief Arguments

Claims 1 and 13

Independent claims 1 and 13 were rejected under 35 U.S.C. §103(a) as being unpatentable over Madsen in view of MacFarlane et al. With regards to claim 1, for example, the Examiner asserts that Madsen discloses a method for compensating for polarization mode dispersion in an optical fiber communication system (citing Figures 1-3), comprising the steps of: reducing said polarization mode dispersion using a cascade of all-pass filters (citing Abstract and Fig. 3); and adjusting coefficients of said all-pass filters. (citing page 535, left column, first complete par.).

The Examiner acknowledges that Madsen adjusts the coefficients using a least square algorithm. (citing page 535, left column, first complete par.), but do **not** disclose adjusting the coefficients using a *least mean square algorithm*. The Examiner asserts, however, that MacFarlane et al. teach a system related to Madsen including optical filters for compensating for polarization mode dispersion having adjusted coefficients (col. 1, lines 28-53, col. 2, lines 51-65 and col. 5, lines 23-42). The Examiner further asserts that MacFarlane et al. teach that the filter coefficients can be adjusted using a variety of minimization algorithms including a least squares algorithm or an LMS algorithm (col. 19, lines 16-22).

Contrary to the Examiner's assertion, while MacFarlane et al. may address optical filtering and polarization, there is no disclosure or suggestion to *compensate for polarization mode dispersion*. The term "polarization mode dispersion" does not even seem to appear in MacFarlane et al.

Thus, MacFarlane et al. does not disclose or suggest the step of "reducing said polarization mode dispersion." In addition, MacFarlane et al. does not disclose or suggest that the polarization mode dispersion is reduced "using a cascade of all-pass filters," and the Examiner has not alleged that MacFarlane et al. discusses all-pass filters.

In addition, again contrary to the Examiner's assertion, MacFarlane et al. does **not** teach that the filter coefficients can be adjusted using a variety of minimization algorithms including an LMS algorithm (citing col. 19, lines 16-22). *While the LMS algorithm is discussed at col. 19, lines 16-22, it is **not** in connection with the adjustment of filter coefficients*. Rather, the discussion at col. 19, lines 16-22 is directed to adjusting "the gains on an on-going basis (of a network traffic router) to minimize error correction coding related error rates" (lines 11-13). It is

further noted that as "the gains are adjusted, the control signal values in the look-up tables are also preferably updated as well." *Id.* at lines 14-16. Appellant can find ***no*** disclosure or suggestion in MacFarlane et al. to adjust the ***coefficients of a filter*** (especially an all-pass filter) using the LMS algorithm (and especially in the context of reducing polarization mode dispersion).

Appellant has previously acknowledged that the use of the LMS algorithm for adapting FIR filters is both well-known and straightforward. Appellant strongly asserts, however, that it would not have been obvious to a person of ordinary skill in the art to apply the LMS algorithm to the adaptation of all-pass filters. It is not known to adapt all-pass filters using the LMS algorithm. Furthermore, the adaptation equations for FIR filters do not apply to the adaptation of an all-pass filter.

An Examiner must establish "an apparent reason to combine … known elements." *KSR International Co. v. Teleflex Inc. (KSR)*, 550 U.S. ___, 82 USPQ2d 1385 (2007). Here, the Examiner states that it would have been obvious to implement the LMS adaptation of MacFarlane et al. in the system of Madsen as an "engineering design choice" of another way to provide the minimization function. As discussed hereinafter, the use of the LMS algorithm in the manner suggested only by the present invention is more than a mere design choice. Again, any discussion of adaptation using the LMS algorithm is not in the context of adjusting the ***coefficients of a filter*** (especially an all-pass filter in the context of reducing polarization mode dispersion).

Appellant is claiming a new technique for compensating for polarization mode dispersion in an optical fiber communication system *by* using a cascade of all-pass filters; and adjusting coefficients of said all-pass filters *using a least mean square algorithm.*

There is no suggestion in Madsen or in MacFarlane et al., alone or in combination, to adjust coefficients of a cascade of all-pass filters *using a least mean square algorithm.*

In further support of Appellant's position that it would not have been obvious to a person of ordinary skill in the art to apply the LMS algorithm to the adaptation of all-pass filters, Appellant notes that for most applications, an all-pass filter is not advantageous and an FIR filter is much easier to implement. Thus, persons of ordinary skill in the art are inclined to use FIR filters and due to the complexity of an implementation with an all-pass filter, would not be

motivated to substitute an all-pass filter for an FIR filter, in the manner suggested by the Examiner. In addition, since the adaptation equations for FIR filters do not apply to the adaptation of an all-pass filter, the combination suggested by the Examiner *would not work*.

The above-noted complexity of an implementation with an all-pass filter also strongly contradicts the Examiner's contention that the combination is motivated by a desire to "quickly and accurately compensate (for) dispersion." In addition, this strong inclination by those of ordinary skill towards the use of FIR filters makes the proposed combination more than a mere "substitution" of one minimization algorithm for another.

This information known to those of ordinary skill in the art ***teaches away*** from the present invention. The *KSR* Court discussed in some detail United States v. Adams, 383 U.S. 39 (1966), stating in part that in that case, "[t]he Court relied upon the corollary principle that when the prior art teaches away from combining certain known elements, discovery of a successful means of combining them is more likely to be nonobvious." (KSR Opinion at p. 12). Thus, there is no reason to make the asserted combination/modification.

Claims 7 and 18

Independent claims 7 and 18 were rejected under 35 U.S.C. §103(a) as being unpatentable over Madsen in view of Eyal et al. With regards to claims 7 and 18, the Examiner again asserts that Madsen discloses a method for compensating for polarization mode dispersion in an optical fiber communication system (citing Figures 1-3), comprising the steps of: reducing said polarization mode dispersion using a cascade of all-pass filters (citing Abstract and Fig. 3); and adjusting coefficients of said all-pass filters. (citing 3rd full par. of col. 1 on page 879).

The Examiner acknowledges that Madsen adjusts the coefficients using a least square algorithm. (citing page 535, left column, first complete par.), but do **not** disclose adjusting the coefficients using a *Newton algorithm*. The Examiner asserts, however, that various optimization algorithms are known and that Eyal et al. teach in a system including optical filters for compensating for polarization mode dispersion having adjusted coefficients (page 1088) Eyal et al. further teach that the filter coefficients are adjusted using a Newton algorithm (citing page 1089, end of first par. of right column).

Eyal et al. does not disclose or suggest that the polarization mode dispersion is reduced "using a cascade of all-pass filters," and the Examiner has not alleged that Eyal et al. discusses all-pass filters.

In addition, contrary to the Examiner's assertion, Eyal et al. does **not** teach that filter coefficients are adjusted using a Newtown algorithm in the discussion on page 1089, end of first par. of right column. While the Newton algorithm is discussed in this passage, it is **not** in connection with the adjustment of filter coefficients. Rather, the discussion at page 1089, end of first par. of right column, is directed to correction of *optimization variables*. The *optimization variables* are clearly distinct from the coefficients in the preceding discussion in the same paragraph.

Appellant has already acknowledged that the use of the Newton algorithm for adapting FIR filters is both well-known and straightforward. Appellant strongly asserts, however, that it would not have been obvious to a person of ordinary skill in the art to apply the Newton algorithm to the adaptation of all-pass filters. It is not known to adapt all-pass filters using the Newton algorithm. Furthermore, the adaptation equations for FIR filters do not apply to the adaptation of an all-pass filter.

An Examiner must establish "an apparent reason to combine … known elements." *KSR International Co. v. Teleflex Inc. (KSR)*, 550 U.S. ___, 82 USPQ2d 1385 (2007). Here, the Examiner merely states that it would have been obvious to implement the Newtown adaptation of Eyal et al. in the system of Madsen as an "engineering design choice" of another way to provide the minimization function. As discussed hereinafter, the use of the Newton algorithm in the manner suggested only by the present invention is more than a mere design choice.

Appellant is claiming a new technique for compensating for polarization mode dispersion in an optical fiber communication system *by* using a cascade of all-pass filters; and adjusting coefficients of said all-pass filters *using a Newtn algorithm.*

There is no suggestion in Madsen or in Eyal et al., alone or in combination, to adjust coefficients of a cascade of all-pass filters *using a Newton algorithm.*

In further support of Appellant's position that it would not have been obvious to a person of ordinary skill in the art to apply the Newton algorithm to the adaptation of all-pass filters, Appellant notes that for most applications, an all-pass filter is not advantageous and an FIR filter is much easier to implement. Thus, persons of ordinary skill in the art are inclined to use FIR filters and due to the complexity of an implementation with an all-pass filter, would not be motivated to substitute an all-pass filter for an FIR filter, in the manner suggested by the

Examiner. In addition, since the adaptation equations for FIR filters do not apply to the adaptation of an all-pass filter, the combination suggested by the Examiner would not work.

The above-noted complexity of an implementation with an all-pass filter also strongly contradicts the Examiner's contention that the combination is motivated by a desire to "quickly and accurately compensate (for) dispersion." In addition, this strong inclination by those of ordinary skill towards the use of FIR filters makes the proposed combination more than a mere "substitution" of one minimization algorithm for another.

This information known to those of ordinary skill in the art ***teaches away*** from the present invention. The *KSR* Court discussed in some detail United States v. Adams, 383 U.S. 39 (1966), stating in part that in that case, "[t]he Court relied upon the corollary principle that when the prior art teaches away from combining certain known elements, discovery of a successful means of combining them is more likely to be nonobvious." (KSR Opinion at p. 12). Thus, there is no reason to make the asserted combination/modification.

Appellant respectfully requests the withdrawal of the rejection of independent claims 1, 7, 13 and 18.

Dependent Claims

Claims 2-6, 8-12, 14-17 and 19-22 are dependent on independent claims 1, 7, 13 and 18, and are therefore patentably distinguished over Madsen, MacFarlane et al., Eyal et al. and Wang et al., alone or in any combination, because of their dependency from independent claims 1, 7, 13 and 18 for the reasons set forth above, as well as other elements these claims add in combination to their base claim.

The Examiner has already indicated that Claims 6 and 12 would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Conclusion

All of the pending elaims, i.e., claims 1-22, are in condition for allowance and such favorable action is earnestly solicited.

If any outstanding issues remain, or if the Examiner or the Appeal Board has any further suggestions for expediting allowance of this application, the Examiner and the Appeal Board are invited to contact the undersigned at the telephone number indicated below.

The attention of the Examiner and the Appeal Board to this matter is appreciated.

Respectfully submitted,

Date: December 24, 2008

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APPENDIX

1. A method for compensating for polarization mode dispersion in an optical fiber communication system, comprising the steps of:

reducing said polarization mode dispersion using a cascade of all-pass filters; and

adjusting coefficients of said all-pass filters using a least mean square algorithm.

2. The method of claim 1, wherein said cascade of all-pass filters comprises a two-channel structure consisting of multiple cascades of all-pass filters and directional couplers.

3. The method of claim 1, wherein said coefficient values are adjusted to minimize a cost function.

4. The method of claim 1, further comprising the step of measuring said polarization mode dispersion in a received optical signal.

5. The method of claim 4, wherein said measuring step employs a tunable narrowband optical filter to render information from energy detector measurements.

6. The method of claim 1, wherein said cascade of all-pass filters comprises a first all-pass filter A having a vector a comprised of P coefficients and a second all-pass filter B having a vector b comprised of Q coefficients and wherein said least mean square algorithm adjusts said coefficients as follows:

$$\mathrm{w}(n+1) = \mathrm{w}(n) - \mu\nabla(J),$$

where n indicates the current iteration number and w is a composite coefficient vector defined as:

$$\mathrm{w} = \begin{bmatrix} \mathrm{a} \\ \mathrm{b} \end{bmatrix},\ \nabla(J) \equiv \begin{bmatrix} \dfrac{\partial J}{\partial \mathrm{a}^T} & \dfrac{\partial J}{\partial \mathrm{b}^T} \end{bmatrix}^T$$

is the $(P+Q)\times 1$ complex gradient of J with respect to w and T indicates a transpose operation, and

$$\frac{\partial J}{\partial \mathrm{a}^T} \equiv \begin{bmatrix} \dfrac{\partial J}{\partial a_1} & \dfrac{\partial J}{\partial a_2} & \cdots & \dfrac{\partial J}{\partial a_P} \end{bmatrix},\ \text{and}$$

$$\frac{\partial J}{\partial \mathrm{b}^T} \equiv \begin{bmatrix} \frac{\partial J}{\partial b_1} & \frac{\partial J}{\partial b_2} & \cdots & \frac{\partial J}{\partial b_Q} \end{bmatrix}.$$

7. A method for compensating for polarization mode dispersion in an optical fiber communication system, comprising the steps of:

reducing said polarization mode dispersion using a cascade of all-pass filters; and adjusting coefficients of said all-pass filters using a Newton algorithm.

8. The method of claim 7, wherein said cascade of all-pass filters comprises a two-channel structure consisting of multiple cascades of all-pass filters and directional couplers.

9. The method of claim 7, wherein said coefficient values are adjusted to minimize a cost function.

10. The method of claim 7, further comprising the step of measuring said polarization mode dispersion in a received optical signal.

11. The method of claim 10, wherein said measuring step employs a tunable narrowband optical filter to render information from energy detector measurements.

12. The method of claim 7, wherein said cascade of all-pass filters comprises a first all-pass filter A having a vector a comprised of P coefficients and a second all-pass filter B having a vector b comprised of Q coefficients and wherein said Newton algorithm adjusts said coefficients as follows:

$$\mathrm{w}(n+1) = \mathrm{w}(n) - \mu \mathrm{H}^{-1}\nabla(J)$$

where n indicates the current iteration number and w is a composite coefficient vector defined as:

$$\mathrm{w} = \begin{bmatrix} \mathrm{a} \\ \mathrm{b} \end{bmatrix},\ \nabla(J) \equiv \begin{bmatrix} \frac{\partial J}{\partial \mathrm{a}^T} & \frac{\partial J}{\partial \mathrm{b}^T} \end{bmatrix}^T$$

$\frac{\partial J}{\partial \mathrm{a}^T} \equiv \begin{bmatrix} \frac{\partial J}{\partial a_1} & \frac{\partial J}{\partial a_2} & \cdots & \frac{\partial J}{\partial a_P} \end{bmatrix}$, is the $(P+Q)\times 1$ complex gradient of J with respect to w. T indicates a transpose operation and, a Hessian matrix, H, is defined as follows:

$$H = \frac{\partial^2 J}{\partial w \partial w^t} = \begin{bmatrix} \frac{\partial^2 J}{\partial a \partial a^t} & \frac{\partial^2 J}{\partial a \partial b^t} \\ \frac{\partial^2 J}{\partial b \partial a^t} & \frac{\partial^2 J}{\partial b \partial b^t} \end{bmatrix} \text{ and}$$

$$\frac{\partial J}{\partial b^t} \equiv \begin{bmatrix} \frac{\partial J}{\partial b_1} & \frac{\partial J}{\partial b_2} & \cdots & \frac{\partial J}{\partial b_Q} \end{bmatrix}.$$

13. A polarization mode dispersion compensator in an optical fiber communication system, comprising:

a cascade of all-pass filters having coefficients that are adjusted using a least mean square algorithm.

14. The polarization mode dispersion compensator of claim 13, wherein said cascade of all-pass filters comprises a two-channel structure consisting of multiple cascades of all-pass filters and directional couplers.

15. The polarization mode dispersion compensator of claim 13, wherein said coefficient values are adjusted to minimize a cost function.

16. The polarization mode dispersion compensator of claim 13, further comprising a polarization mode dispersion measuring device for measuring said polarization mode dispersion in a received optical signal.

17. The polarization mode dispersion compensator of claim 16, wherein said polarization mode dispersion measuring device employs a tunable narrowband optical filter to render information from energy detector measurements.

18. A polarization mode dispersion compensator in an optical fiber communication system, comprising:

a cascade of all-pass filters having coefficients that are adjusted using a Newton algorithm.

19. The polarization mode dispersion compensator of claim 18, wherein said cascade of all-pass filters comprises a two-channel structure consisting of multiple cascades of all-pass filters and directional couplers.

20. The polarization mode dispersion compensator of claim 18, wherein said coefficient values are adjusted to minimize a cost function.

21. The polarization mode dispersion compensator of claim 18, further comprising a polarization mode dispersion measuring device for measuring said polarization mode dispersion in a received optical signal.

22. The polarization mode dispersion compensator of claim 21, wherein said polarization mode dispersion measuring device employs a tunable narrowband optical filter to render information from energy detector measurements.

EVIDENCE APPENDIX

There is no evidence submitted pursuant to § 1.130, 1.131, or 1.132 or entered by the Examiner and relied upon by appellant.

RELATED PROCEEDINGS APPENDIX

There are no known decisions rendered by a court or the Board in any proceeding identified pursuant to paragraph (c)(1)(ii) of 37 CFR 41.37.